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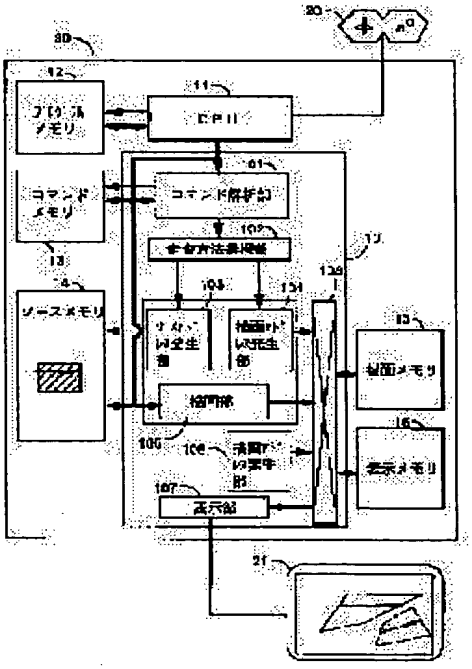
(54) PLOTTING METHOD AND GRAPHIC DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To provide a graphic device which executes a high speed texture mapping processing while high picture quality is kept.
SOLUTION: A graphic processor 10 is provided with a scanning method selection part 102. Either a mode for horizontally scanning data of a source picture area by one dot or a mode for horizontally scanning data of a plotting picture area by one dot is selected by designation from a command and the characteristic (number of angles and flat rate calculation result) of a graphic.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] In the drawing approach by the texture mapping which transforms a source image free and draws The scan which carries out the level scan of every 1 dot of the source image fields, and is mapped to a drawing image field as a scan method of texture mapping (it is hereafter called a source level scan), Or the drawing approach characterized by choosing dynamically the scan (it being hereafter called a drawing level scan) which carries out the level scan of every 1 dot of said drawing image field, and is mapped from said source image field according to a predetermined criterion.
[Claim 2] it be the drawing approach characterize by choose said drawing level scan when the oblateness , as for said criterion , the class of drawing graphic form indicate extent of deformation of a drawing graphic form of the exterior (or interior) of a specific window and a drawing graphic form to be below n square shape in claim 1 be size and satisfy these one from a **** value , and choose said source level scan when not satisfy these all .
[Claim 3] It is the drawing approach characterized by for said oblateness computing the maximum height or the maximum height / base of a drawing graphic form in claim 2, and asking.
[Claim 4] The drawing approach characterized by thinning out and specifying the number of scan lines of a source image field by the scan which carries out the level scan of every 1 dot of the source image fields, and is mapped to a drawing image field in the drawing approach by the texture mapping which transforms a source image free and draws.
[Claim 5] It is the drawing approach characterized by making into the minimum value the number of scan lines with which said number of scan lines thinned out and specified is equivalent to the graphic form height of said drawing image field in claim 4.
[Claim 6] It is graphics equipment which sets to graphics equipment equipped with the drawing processor which carries out texture mapping of CPU which directs the image which should draw, the image memory which has a source image field and a drawing image field, respectively, and the data of said source image field to said drawing image field, and is characterized by for said drawing processor to have a scan method selection means determine one of two or more of the scan methods of said texture mapping according to assignment in the mode from said CPU.
[Claim 7] A graphic device including the scan (it is hereafter called a source level scan) which carries out the level scan of every 1 dot of said source image field, and is mapped to a drawing image field in said two or more scan methods in claim 6, and the scan (it is hereafter called a drawing level scan) which carries out the level scan of every 1 dot of said drawing image field, and is mapped from a source image field.
[Claim 8] The graphic device characterized by including the fixed mode of an application unit, the fixed mode of a polygon unit, and the automatic mode determined by said drawing processor side in assignment in said mode in claims 6 or 7.
[Claim 9] Graphics equipment characterized by including the field which specifies said source level scan or said drawing level scan in the command from said CPU in claim 7.
[Claim 10] Said scan method selection means is graphics equipment characterized by determining the scan method for every polygon dynamically according to predetermined criteria when said automatic mode is specified as the command from said CPU in claim 8.

[Claim 11] It is graphics equipment characterize by choose said source level scan when satisfy one of the criteria which , as for said automatic mode , the exterior (interior) of the window of specification [the graphic form kind of a drawing graphic form / a triangle and a drawing graphic form] and the oblateness of a drawing graphic form become from size from a **** value in claim 10 and not satisfy said all criteria for said drawing level scan .
[Claim 12] It is graphics equipment characterized by having an operation means to compute the oblateness of the drawing graphic form with which said scan method selection means carries out texture mapping in claim 11.
[Claim 13] CPU which directs the image which should draw, and the image memory which has a source image field and a drawing image field, respectively, In graphics equipment equipped with the drawing processor which carries out texture mapping of the data of said source image field to said drawing image field Graphics equipment characterized by having the field which thins out and directs the number of scan lines of a source image field by the scan which carries out the level scan of every 1 dot of the source image fields, and is mapped to a drawing image field in the command of said CPU or said drawing processor.
[Claim 14] It is graphics equipment characterized by setting up the value which calculated the number of Rhine to which said number of scan lines draws a drawing image in claim 13 based on the top-most-vertices coordinate location of a polygon.
[Claim 15] It is graphics equipment characterized by having two or more bits which specify Rhine which said field draws in claims 13 or 14 corresponding to the bit position, and Rhine which does not draw.
[Claim 16] CPU which directs the image which should draw, and the image memory which has a source image field and a drawing image field, respectively, In graphics equipment equipped with the drawing processor which carries out texture mapping of the data of said source image field to said drawing image field said drawing processor The scan which carries out the level scan of every 1 dot of said source image field, and is mapped to a drawing image field as a scan method of said texture mapping (it is hereafter called a source level scan), The scan which carries out the level scan of every 1 dot of said drawing image field, and is mapped from a source image field Graphics equipment characterized by having the field which establishes a scan method selection means to choose one of (the calling it a drawing level scan hereafter), and thins out and directs the number of scan lines of said source image field in said source level scan into the command of said drawing processor.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention is used by the amusement device, the pictorial communication terminal, a printer, etc., and relates to the texture mapping drawing approach especially about the graphic device which processes and edits image data and outputs it.
[0002]
[Description of the Prior Art] In recent years, with graphics equipment, processing which carries out deformation drawing of the source image of the rectangle called texture mapping free is realized, and 3D-Graphics which is full of presence is realized. Drawing of this texture mapping was using the mode (it is hereafter called a drawing level scan) which carries out the level scan of every 1 dot of the drawing image fields, and is mapped from a source image field fixed as a means generate the texture address, like a JP,6-28485,A publication like the mode (it is hereafter called a source level scan) which carries out the level scan of every 1 dot of the source image fields, and is mapped to a drawing image field, or a JP,1-32393,A publication.
[0003]
[Problem(s) to be Solved by the Invention] In the above-mentioned Prior art, there was a problem that the advantages and disadvantages of each texture-mapping scan method could not be used effectively. That is, although the natural three-dimension image was generable with the source level scan, when drawing the image which carried out flat, in order to prevent the omission of a drawing image, much overwrite occurred, and there was a problem that writing speed fell extremely. On the other hand, with the drawing level scan, although it did not generate, when the above overwrite drew a square, the image became superficial and they had the problem that discontinuity was conspicuous.
[0004] The purpose of this invention is to offer the high graphics equipment of the grade which applied the high definition drawing approach and its technique at the high speed by texture mapping.
[0005]
[Means for Solving the Problem] In the drawing approach by the texture mapping which deforms the description of this invention for attaining the above-mentioned purpose for a source image free, and draws The scan which carries out the level scan of every 1 dot of the source image fields, and is mapped to a drawing image field as a scan method of texture mapping (it is hereafter called a source level scan), Or it is in choosing dynamically the scan (it being hereafter called a drawing level scan) which carries out the level scan of every 1 dot of said drawing image field, and is mapped to said source image field according to a predetermined criterion.
[0006] Said criterion chooses said drawing level scan, when the oblateness which shows extent of deformation [the class of drawing graphic form] of the exterior (or interior) of a specific window and a drawing graphic form of below n square shape and a drawing graphic form is size and satisfies these one from a **** value, and when not satisfying these all, it chooses said source level scan.
[0007] CPU which directs the image which should draw as equipment adapting such a drawing approach, It has the drawing processor which carries out texture mapping of the image memory

which has a source image field and a drawing image field, respectively, and the data of said source image field to said drawing image field. Said drawing processor is realized as graphics equipment characterized by having a scan method selection means to determine one of two or more of the scan methods of said texture mapping according to assignment in the mode from said CPU.
[0008] In the case of this automatic mode, according to said criteria, the scan method for every polygon is dynamically determined at assignment in said mode including the fixed mode of an application unit, the fixed mode of a polygon unit, and the automatic mode determined by said drawing processor side.
[0009] Other descriptions of this invention for attaining the above-mentioned purpose are in the drawing approach by the texture mapping which transforms a source image free and draws to thin out and specify the number of scan lines of the source image field of said source level scan.

[0010] Said number of scan lines thinned out and specified makes the minimum value the number of scan lines equivalent to the graphic form height of said drawing image field.
[0011] CPU which directs the image which should draw as other equipments adapting such a drawing approach, It has the drawing processor which carries out texture mapping of the image memory which has a source image field and a drawing image field, respectively, and the data of said source image field to said drawing image field. It realizes as a graphic device characterized by having the field which thins out and directs the number of scan lines of the source image field in said source level scan into the command of said CPU or said drawing processor.
[0012]
[Function] Since according to this invention a high definition source level scan or a high-speed drawing level scan is chosen and theque char mapping is performed according to assignment by the command, the property of a drawing graphic form, etc., both the processability and image quality of drawing can be improved.
[0013] Since the optimal scan method which judged the classification of a drawing graphic form, relation with a specific window or extent of deformation, etc. for every polygon, and was especially seen from image quality and both sides of processability can be determined dynamically, the high graphics equipment of grade can be offered.
[0014] Moreover, since the number of source drawing Rhine of said source level scan can be thinned out and specified, processability can be improved maintaining image quality and it also becomes possible to complete drawing processing in the predetermined time which can follow in the real time's footsteps etc.
[0015]
[Example] Hereafter, one example of this invention is explained with reference to drawing.
[0016] Drawing 1 is the block block diagram of the high-speed graphics equipment 30 of one example of this invention. Based on directions of the input pad 20, high-speed graphics equipment 30 performs an application program by CPU11, and directs the image which should draw to a graphics processor 10. The drawing processor 10 compounds a desired image using the drawing memory 15 and display memory 16, and displays it on a monitor 21 via a display 107.
[0017] Hereafter, actuation of this equipment is explained. CPU11 creates the command and source data which should be processed using program memory 12, and transmits them to a graphics processor 10. A graphics processor 10 memorizes a command and source data in the command memory 13 and the source memory 14 temporarily. What was generated for itself [graphics processor 10] is included in this command.
[0018] Then, CPU11 publishes an activation initiation command. With an activation initiation command, the command analysis section 101 in a graphics processor 10 takes out a command from the command memory 13, transmits a required parameter to the scan method selection section 102, and starts it.
[0019] The scan method selection section 102 determines a scan method according to the command and parameter from the command analysis section 101. And the coordinate and drawing coordinate in which source data are stored are calculated, and the source address generating section 103 is started. Similarly the coordinate and drawing coordinate which store a

drawing result are calculated, and the drawing address generation section 104 is started.
[0020] In the source address generating section 103 and the drawing address generation section 104, by the scan technique of the texture mapping specified from the scan method selection section 102, the coordinate and drawing coordinate in which source data are stored are calculated, and the source memory 14 and the drawing memory 15 are accessed. That is, when the specified scan method is a source level scan, the level scan of every 1 dot of the source image fields is carried out, and it maps to a drawing image field. Moreover, in a drawing level scan, the level scan of every 1 dot of the drawing image fields is carried out, and it maps them from a source image field.
[0021] Processing processing is carried out in the drawing section 105, and the source data read from the source memory 14 are written in the drawing memory 15. The drawing memory 15 and display memory 16 are making the shift buffer which changes with a switch 108, and the image written in with the front frame is stored in display memory 16. Display memory 16 is accessed in the address generated in the display address generation section 106, and read-out data are outputted and displayed on a monitor 21 via a display 107.
[0022] Drawing 2 is the conceptual diagram of the scan method of texture mapping. The source level scan which this drawing (a) and (b) carry out the level scan of every 1 dot of the data of a source image field, and is mapped to a drawing image field is shown, (a) shows the scan processing by the side of the source, and (b) shows the scan processing by the side of drawing. Like illustration, in this mode, the Y coordinate by the side of the source is fixed, and it advances 1 dot of X coordinate by the side of the source at a time, and this calculates whether it is mapped by which location by the side of drawing, and draws.
[0023] by the drawing approach with a source level scan, in order to stick the square of the source on the longitudinal direction according to the location of the side where it cuts in the shape of [fine] a strip of paper, and a drawing side corresponds, a perpendicular segment bends and reappears like drawing 2 (b) -- having -- false -- a three-dimensional expression is attained and there is a merit which can generate a natural image for appearance. However, if the time amount for scanning all subject-copy images irrespective of the configuration of a drawing image and size is required and especially the drawing image is carrying out flat, overwrite will occur frequently, and there is a fault of needing great drawing time amount.
[0024] The drawing level scan which drawing 2 (c) and (d) carry out the level scan of every 1 dot of the drawing image fields, and is mapped from a source image field is shown, (c) shows the scan processing by the side of the source, and (d) shows the scan processing by the side of drawing. Like illustration, in this mode, the Y coordinate by the side of drawing is fixed, and it advances 1 dot of X coordinate by the side of drawing at a time, and calculates from which location by the side of the source this is mapped, and source data are accessed.
[0025] By the drawing approach with a drawing level scan, in order to count backward from the part drawn, unnecessary overwrite does not occur at all but there is a merit to which high-speed drawing is attained. For example, a drawing surface is not a flat-surface configuration, the inverse operation time amount of a source image becomes however, less practical [increase and] in the case of the texture mapping to a distorted curved surface etc. Moreover, in three-dimension drawing, if a polygon becomes more than a square, an unnatural distortion will occur in the image after texture mapping. Although two or more mapping locations of the source at the time of an inverse operation exist, since the adoption Ruhr is not applied systematically, this is produced.
[0026] This invention specifies two or more scan methods of texture mapping by the command, or makes automatic selection of the optimal scan method from the property of a drawing graphic form etc., realizes the good graphics equipment of image quality at high speed, and explains the detail below.
[0027] Drawing 3 shows the decision processing flow of the scan method by the scan method selection section. It divides roughly into the decision method of a scan method, and there is the mode of 3 of application unit assignment, command assignment, and polygon unit assignment. First, the assignment mode by the command of CPU11 is distinguished (1101), and decision processing of a scan method according to the mode is performed.

[0028] Application unit assignment is the most macroscopic specification method, and is in fixed mode. For example, the scan method of texture mapping is beforehand memorized per application to ROM of the cartridge of a game etc. A drawing level scan is described to a thing [the thing which needs a natural image expression] a source level scan and high-speed drawing as fixed scanning mode assignment information, respectively, and a scan method is determined as it with reference to this information (1102). Fixed scanning mode assignment information is described like the after-mentioned by the scan field in a command.
[0029] Command assignment is automatic mode which determines the scan method of texture mapping dynamically according to criteria, such as oblateness which shows the number n of angles of the graphic form in which the class of drawing graphic form is shown, a drawing coordinate location and the inside-and-outside relation of a specific window, and the configuration of a drawing graphic form. The number n of angles of the graphic form in this example makes the criterion the triangle which an unnatural distortion does not generate after texture mapping.
[0030] The decision algorithm of the scan method by command assignment The class of drawing graphic form judges in a triangle (1104), and a drawing graphic form judges in the outside of a predetermined window (1105). If all are no (NO), will calculate oblateness (1106), and it judges whether oblateness is larger than a **** value (1107). If smaller than a **** value, a source level scan will be chosen (1108), and if either is filled with the above-mentioned judgment (YES), a drawing level scan will be chosen (1109). Here, although three criteria were arranged in order simply, various deformation, such as modification of sequence, combination of a criterion, installation of a performance index, and an addition of other conditions, is easily realizable.
[0031] Polygon unit assignment is in fixed mode in which a scan method is specified for every polygon. With reference to the scan method specified like the after-mentioned, it is decided that it will be the scan field in a command (1103).
[0032] Thus, the assignment technique from CPU11 is distinguished, and by processing according to either application unit assignment, command assignment or polygon unit assignment, a scan method is determined and it directs to the source address generating section 103 and the drawing address generation section 104 (1110).
[0033] Drawing 4 (a) shows an example of the command list of a graphics processor 10. A command list is set up for every polygon and stored in the command memory 13. An operation code shows the class of command. The parameter has prescribed the conditions which accompany a command. The scanning mode appointed field is the field which chooses the scan method of texture mapping. In source address information, the starting address of source data, size, and drawing address information specify a drawing starting address and a configuration. The number of Rhine which draws from this address information is computable. The attribute has described the reference data of the image-processing data used by the pixel operation part 105.
[0034] Drawing 4 (b) shows the detail of the command field of scanning mode assignment information. This command is CPU11 in fixed mode, and is created by CPU11 and the graphics processor 10 with automatic mode.
[0035] 2 bits of command analysis section high orders express a scanning mode assignment bit (SD), and they specify the processing technique for determining the scan mode of texture mapping. The technique of SD=00 is in fixed mode and there is no modification in scan mode. The technique of SD=01 is automatic mode, according to each rice bull bit of a graphic form kind judging (S), a window judging (W), and an oblateness judging (H), a scan method is determined automatically, and dynamic modification of a scan method is attained by this. It is in a source level scan by SD=10, its drawing level scan is in a command list by SD=11, and the individual assignment mode of a polygon unit is specified.
[0036] A graphic form kind judging rice bull bit (S) is a bit which permits considering the registered graphic form kind as a drawing level scan. A window judging rice bull bit (W) is a bit which permits considering the graphic form drawn outside the registered window as a drawing level scan. An oblateness judging rice bull bit (H) calculates the oblateness or its amount of evaluations of the graphic form drawn, and when larger than the registered threshold, it is the bit which permits drawing with a drawing level scan.

[0037] The conceptual diagram of automatic setting of the scan method by window judging is shown in drawing 5 . The specific window 1201 is set as Screen 1200. Graphic forms 1202 other than a window and 1206-1209 consist of stationary simple graphic forms. The graphic form 1203-1205 in a window assumes the screen of the cockpit of a spacecraft, at high speed, moves, and deforms, the complicated configuration is carried out, and drawing has taken much time amount. Therefore, the whole processing is accelerable if the graphic form in a window is drawn at a high speed. At this example, the graphic form in a window is drawn with a high-speed drawing level scan by setting a window judging rice bull bit (W) to 1.
[0038] The conceptual diagram for asking drawing 6 for the oblateness of a graphic form is shown. By the conceptual diagram which normalized the top-most vertices B of a square ABCD as a zero, the X coordinate of Ya and top-most vertices C defines it as Xc, and Y coordinate defines Xa and Y coordinate for the X coordinate of top-most vertices A as Yc. This drawing (a) shows the case of Ya>=Yc and this drawing (b) shows the case of Ya<Yc.
[0039] It is the index which quantifies the deformation of a drawing image compared with oblateness in a source image. The inclination of the side on either side of overwrite occurring frequently is the case that near and graphic form height are horizontally low, to a base. For this reason, maximum (AI of drawing 6) of graphic form height can be made into the amount of evaluations.
[0040] The oblateness of a graphic form can be distinguished by comparing the height of a source graphic form with the height of a drawing graphic form. Distance AE can be resembled if height AI of a drawing graphic form has small angle CBF in the case of drawing 6 (a). Distance AE is the distance AG-distance EG, and distance AG can be calculated with Ya and it can calculate distance EG with Xa*Yc/Xc. A triangle BGE and a triangle BFC are analogs and this is because EG:CF=BG:BF is materialized. In this case, the value of calculated AE includes the error compared with the value of true AI. However, AI does not exceed AE.
[0041] Similarly, since AI can be approximated with AK in the case of drawing 6 (b), it is calculable with AK=Xc*Ya/Yc-Xa from AK=JB and JB=JG-BG. A triangle JGA and a triangle BFC are analogs and this is because JG:BF=AG:CF is materialized. Although AK calculated also in this case includes the error compared with true AI, AI does not exceed AK.
[0042] Although the amount of evaluations of oblateness was made into graphic form height in the above-mentioned example, it is good also by the include angle (the angle ABC of drawing 6) which height, the ratio of a base and a base, and the side side make. In addition, graphic form height is applicable also to the decision of the number of drawing Rhine mentioned later.
[0043] According to this example, a high-definition source level scan and a high-speed drawing level scan can be automatically chosen as a scan method of texture mapping according to the assignment from CPU, a predetermined polygon property, etc.
[0044] Moreover, since a scan method can be dynamically changed according to the oblateness calculated from inside-and-outside relation or a polygon configuration with graphic form classification and a specific window, it can improve in both processability and image quality. In addition, selection by the drawing processing time demanded is also possible as one of the criteria.
[0045] Next, the technique of accelerating a source level scan is explained with reference to drawing 4 (b) as other examples of this invention.
[0046] By the source level scanning method, in order to scan and draw only the height of the source, if the drawing image is carrying out flat, much overwrite will occur. For this reason, the height of the graphic form which draws is calculated, the number of Rhine required for drawing is acquired, and if the scan of the source is thinned out and it draws so that this number of Rhine may be suited, only that part can accelerate processing.
[0047] The skip mode (KM) of the scanning mode appointed field is assignment from CPU11 or a graphics processor 10, and changes the number of scan lines of a source level scan. The Rhine skip is performed by the pattern which specified only the number of Rhine which specified by ** Rhine drawing KM=00 and was specified with the number LN (8 bits) of scan lines by KM=01 by the scan **** pattern PT (8 bits) by drawing and KM=10.
[0048] At the time of KM=01, when drawing Rhine of LN book, it is necessary to average and thin

out. For this reason, L=L+M repeats and determines scan line L on the basis of the number LN of drawing Rhine (M=LN). When it comes to L> (the total number AN of Rhine of the source), the decision of the scan line by above-mentioned L=L+M is repeated, using the fraction (overspeed) as new M (= L-AN).
[0049] At the time of KM=10, although infanticide is directed by the pattern of PT, it scans from the high order bit of PT, it moves to next Rhine without drawing, if an applicable bit is 1, and if an applicable bit is 0, it will draw. If it comes to the least significant bit, it will return and repeat to the most significant bit of PT again. For example, PT pattern of 50% infanticide is the case (10101010) where the field is 8 bits.
[0050] In the above-mentioned example, although the number LN of drawing Rhine is set up with the command from CPU, the bit of oblateness is prepared in the scanning mode appointed field, and it is also easily realizable to set the number of scan lines automatically based on the graphic form height which is the amount of evaluations of oblateness. For example, the number of Rhine equivalent to the height of a drawing graphic form (the number of dots) is set up as the minimum value of the number of scan lines of a source graphic form.
[0051] The technique of improvement in the speed the source level scan by this example is conventionally [which does not have the scan method selection section 102 in a graphics processor 10] applicable also to the graphics equipment of a type as it is. In this case, the skip mode (KM) of the scanning mode appointed field is specified from CPU.
[0052] Rhine which according to the source level scan of this example should limit the number of Rhine of drawing or should draw — a number of — it is — a pattern setup of Rhine which does not draw is carried out, it is made to decide, before processing the number of processing Rhine to operate on a curtailed schedule, and drawing is accelerable, maintaining image quality.
[0053] Next, drawing 7 - drawing 9 explain the example of 1 application of the hardware configuration which realizes the graphics equipment of this invention.
[0054] Drawing 7 shows the hardware configuration of the scan method setting section 102. The address MA from the command analysis section 101 is decoded by the address decoder 121, and Data MD are written in Rn from a register Ra 1. If a control signal Trig is inputted, a sequencer 122 will operate and the flow of drawing 3 will be performed using Rn from ALUa, ALUb, and a register Ra 1. The source address and the drawing address which were generated here are sent to the source address generating section 103 and the drawing address generation section 104 through Buses MLA and MLB.
[0055] Drawing 8 shows the block diagram of the source address generating section 103 and the drawing address generation section 104. DDA of writing and address generation is started for the address parameter created in the scan method setting section 102 to the register chosen by the address MA from the command analysis section 101. A source and drawing side also serves as the same configuration.
[0056] Drawing 9 shows the block diagram of the drawing section 105. Timing adjustment is carried out by latches 1054 and 1055, and the source data read in the address of the source address generating section 103 are inputted into the synthetic vessel 1056. Via latch 1051, it connects with a computing element 1052 and a register 1053, and interpolation processing of the superposition data DD generated in the scan method setting section 102 is carried out. It connects with the input of one of the two of the synthetic vessel 1056, and this data by which interpolation processing was carried out is compounded with source data, and writes in the drawing memory 15 via latch 1057.
[0057]
[Effect of the Invention] Since according to this invention a high definition source level scan or a high-speed drawing level scan is chosen and theque char mapping is performed according to assignment by the command, the property of a drawing graphic form, etc., user-friendliness can improve both the processability and image quality of drawing well.
[0058] Since the optimal scan method which judged the property of a drawing graphic form etc. for every polygon, and was seen from image quality and both sides of processability can be determined dynamically according to this invention, the high graphics equipment of grade can be offered.

[0059] According to this invention, since the number of source drawing Rhine of a source level scan can be thinned out and specified, the processability of a high definition source level scan can be improved. Moreover, it also becomes possible to complete drawing processing in predetermined time (for example, the real time or a processing termination predetermined time).

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TECHNICAL FIELD

[Industrial Application] This invention is used by the amusement device, the pictorial communication terminal, a printer, etc., and relates to the texture mapping drawing approach especially about the graphic device which processes and edits image data and outputs it.

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PRIOR ART

[Description of the Prior Art] In recent years, with graphics equipment, processing which carries out deformation drawing of the source image of the rectangle called texture mapping free is realized, and 3D-Graphics which is full of presence is realized. Drawing of this texture mapping was using the mode (it is hereafter called a drawing level scan) which carries out the level scan of every 1 dot of the drawing image fields, and is mapped from a source image field fixed as a means generate the texture address, like a JP,6-28485,A publication like the mode (it is hereafter called a source level scan) which carries out the level scan of every 1 dot of the source image fields, and is mapped to a drawing image field, or a JP,1-32393,A publication.

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EFFECT OF THE INVENTION

[Effect of the Invention] Since according to this invention a high definition source level scan or a high-speed drawing level scan is chosen and theque char mapping is performed according to assignment by the command, the property of a drawing graphic form, etc., user-friendliness can improve both the processability and image quality of drawing well.
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[0059] According to this invention, since the number of source drawing Rhine of a source level scan can be thinned out and specified, the processability of a high definition source level scan can be improved. Moreover, it also becomes possible to complete drawing processing in predetermined time (for example, the real time or a processing termination predetermined time).

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] In the above-mentioned Prior art, there was a problem that the advantages and disadvantages of each texture-mapping scan method could not be used effectively. That is, although the natural three-dimension image was generable with the source level scan, when drawing the image which carried out flat, in order to prevent the omission of a drawing image, much overwrite occurred, and there was a problem that writing speed fell extremely. On the other hand, with the drawing level scan, although it did not generate, when the above overwrite drew a square, the image became superficial and they had the problem that discontinuity was conspicuous.
[0004] The purpose of this invention is to offer the high graphics equipment of the grade which applied the high definition drawing approach and its technique at the high speed by texture mapping.

[Translation done.]

* NOTICES *

MEANS

[Means for Solving the Problem] In the drawing approach by the texture mapping which deforms the description of this invention for attaining the above-mentioned purpose for a source image free, and draws The scan which carries out the level scan of every 1 dot of the source image fields, and is mapped to a drawing image field as a scan method of texture mapping (it is hereafter called a source level scan), Or it is in choosing dynamically the scan (it being hereafter called a drawing level scan) which carries out the level scan of every 1 dot of said drawing image field, and is mapped to said source image field according to a predetermined criterion.
[0006] Said criterion chooses said drawing level scan, when the oblateness which shows extent of deformation [the class of drawing graphic form] of the exterior (or interior) of a specific window and a drawing graphic form of below n square shape and a drawing graphic form is size and satisfies these one from a **** value, and when not satisfying these all, it chooses said source level scan.
[0007] CPU which directs the image which should draw as equipment adapting such a drawing approach, It has the drawing processor which carries out texture mapping of the image memory which has a source image field and a drawing image field, respectively, and the data of said source image field to said drawing image field. Said drawing processor is realized as graphics equipment characterized by having a scan method selection means to determine one of two or more of the scan methods of said texture mapping according to assignment in the mode from said CPU.
[0008] In the case of this automatic mode, according to said criteria, the scan method for every polygon is dynamically determined at assignment in said mode including the fixed mode of an application unit, the fixed mode of a polygon unit, and the automatic mode determined by said drawing processor side.
[0009] Other descriptions of this invention for attaining the above-mentioned purpose are in the drawing approach by the texture mapping which transforms a source image free and draws to thin out and specify the number of scan lines of the source image field of said source level scan.

[0010] Said number of scan lines thinned out and specified makes the minimum value the number of scan lines equivalent to the graphic form height of said drawing image field.
[0011] CPU which directs the image which should draw as other equipments adapting such a drawing approach, It has the drawing processor which carries out texture mapping of the image memory which has a source image field and a drawing image field, respectively, and the data of said source image field to said drawing image field. It realizes as a graphic device characterized by having the field which thins out and directs the number of scan lines of the source image field in said source level scan into the command of said CPU or said drawing processor.

[Translation done.]

* NOTICES *

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OPERATION

[Function] Since according to this invention a high definition source level scan or a high-speed drawing level scan is chosen and theque char mapping is performed according to assignment by the command, the property of a drawing graphic form, etc., both the processability and image quality of drawing can be improved.
[0013] Since the optimal scan method which judged the classification of a drawing graphic form, relation with a specific window or extent of deformation, etc. for every polygon, and was especially seen from image quality and both sides of processability can be determined dynamically, the high graphics equipment of grade can be offered.
[0014] Moreover, since the number of source drawing Rhine of said source level scan can be thinned out and specified, processability can be improved maintaining image quality and it also becomes possible to complete drawing processing in the predetermined time which can follow in the real time's footsteps etc.

[Translation done.]

* NOTICES *

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EXAMPLE

[Example] Hereafter, one example of this invention is explained with reference to drawing.
[0016] Drawing 1 is the block block diagram of the high-speed graphics equipment 30 of one example of this invention. Based on directions of the input pad 20, high-speed graphics equipment 30 performs an application program by CPU11, and directs the image which should draw to a graphics processor 10. The drawing processor 10 compounds a desired image using the drawing memory 15 and display memory 16, and displays it on a monitor 21 via a display 107.
[0017] Hereafter, actuation of this equipment is explained. CPU11 creates the command and source data which should be processed using program memory 12, and transmits them to a graphics processor 10. A graphics processor 10 memorizes a command and source data in the command memory 13 and the source memory 14 temporarily. What was generated for itself [graphics processor 10] is included in this command.
[0018] Then, CPU11 publishes an activation initiation command. With an activation initiation command, the command analysis section 101 in a graphics processor 10 takes out a command from the command memory 13, transmits a required parameter to the scan method selection section 102, and starts it.
[0019] The scan method selection section 102 determines a scan method according to the command and parameter from the command analysis section 101. And the coordinate and drawing coordinate in which source data are stored are calculated, and the source address generating section 103 is started. Similarly the coordinate and drawing coordinate which store a drawing result are calculated, and the drawing address generation section 104 is started.
[0020] In the source address generating section 103 and the drawing address generation section 104, by the scan technique of the texture mapping specified from the scan method selection section 102, the coordinate and drawing coordinate in which source data are stored are calculated, and the source memory 14 and the drawing memory 15 are accessed. That is, when the specified scan method is a source level scan, the level scan of every 1 dot of the source image fields is carried out, and it maps to a drawing image field. Moreover, in a drawing level scan, the level scan of every 1 dot of the drawing image fields is carried out, and it maps them from a source image field.
[0021] Processing processing is carried out in the drawing section 105, and the source data read from the source memory 14 are written in the drawing memory 15. The drawing memory 15 and display memory 16 are making the shift buffer which changes with a switch 108, and the image written in with the front frame is stored in display memory 16. Display memory 16 is accessed in the address generated in the display address generation section 106, and read-out data are outputted and displayed on a monitor 21 via a display 107.
[0022] Drawing 2 is the conceptual diagram of the scan method of texture mapping. The source level scan which this drawing (a) and (b) carry out the level scan of every 1 dot of the data of a source image field, and is mapped to a drawing image field is shown, (a) shows the scan processing by the side of the source, and (b) shows the scan processing by the side of drawing. Like illustration, in this mode, the Y coordinate by the side of the source is fixed, and it advances 1 dot of X coordinate by the side of the source at a time, and this calculates whether it is mapped by which location by the side of drawing, and draws.

[0023] by the drawing approach with a source level scan, in order to stick the square of the source on the longitudinal direction according to the location of the side where it cuts in the shape of [fine] a strip of paper, and a drawing side corresponds, a perpendicular segment bends and reappears like drawing 2 (b) -- having -- false -- a three-dimensional expression is attained and there is a merit which can generate a natural image for appearance. However, if the time amount for scanning all subject-copy images irrespective of the configuration of a drawing image and size is required and especially the drawing image is carrying out flat, overwrite will occur frequently, and there is a fault of needing great drawing time amount.
[0024] The drawing level scan which drawing 2 (c) and (d) carry out the level scan of every 1 dot of the drawing image fields, and is mapped from a source image field is shown, (c) shows the scan processing by the side of the source, and (d) shows the scan processing by the side of drawing. Like illustration, in this mode, the Y coordinate by the side of drawing is fixed, and it advances 1 dot of X coordinate by the side of drawing at a time, and calculates from which location by the side of the source this is mapped, and source data are accessed.
[0025] By the drawing approach with a drawing level scan, in order to count backward from the part drawn, unnecessary overwrite does not occur at all but there is a merit to which high-speed drawing is attained. For example, a drawing surface is not a flat-surface configuration, the inverse operation time amount of a source image becomes however, less practical [increase and] in the case of the texture mapping to a distorted curved surface etc. Moreover, in three-dimension drawing, if a polygon becomes more than a square, an unnatural distortion will occur in the image after texture mapping. Although two or more mapping locations of the source at the time of an inverse operation exist, since the adoption Ruhr is not applied systematically, this is produced.
[0026] This invention specifies two or more scan methods of texture mapping by the command, or makes automatic selection of the optimal scan method from the property of a drawing graphic form etc., realizes the good graphics equipment of image quality at high speed, and explains the detail below.
[0027] Drawing 3 shows the decision processing flow of the scan method by the scan method selection section. It divides roughly into the decision method of a scan method, and there is the mode of 3 of application unit assignment, command assignment, and polygon unit assignment. First, the assignment mode by the command of CPU11 is distinguished (1101), and decision processing of a scan method according to the mode is performed.
[0028] Application unit assignment is the most macroscopic specification method, and is in fixed mode. For example, the scan method of texture mapping is beforehand memorized per application to ROM of the cartridge of a game etc. A drawing level scan is described to a thing [the thing which needs a natural image expression] a source level scan and high-speed drawing as fixed scanning mode assignment information, respectively, and a scan method is determined as it with reference to this information (1102). Fixed scanning mode assignment information is described like the after-mentioned by the scan field in a command.
[0029] Command assignment is automatic mode which determines the scan method of texture mapping dynamically according to criteria, such as oblateness which shows the number n of angles of the graphic form in which the class of drawing graphic form is shown, a drawing coordinate location and the inside-and-outside relation of a specific window, and the configuration of a drawing graphic form. The number n of angles of the graphic form in this example makes the criterion the triangle which an unnatural distortion does not generate after texture mapping.
[0030] The decision algorithm of the scan method by command assignment The class of drawing graphic form judges in a triangle (1104), and a drawing graphic form judges in the outside of a predetermined window (1105). If all are no (NO), will calculate oblateness (1106), and it judges whether oblateness is larger than a **** value (1107). If smaller than a **** value, a source level scan will be chosen (1108), and if either is filled with the above-mentioned judgment (YES), a drawing level scan will be chosen (1109). Here, although three criteria were arranged in order simply, various deformation, such as modification of sequence, combination of a criterion, installation of a performance index, and an addition of other conditions, is easily realizable.

[0031] Polygon unit assignment is in fixed mode in which a scan method is specified for every polygon. With reference to the scan method specified like the after-mentioned, it is decided that it will be the scan field in a command (1103).
[0032] Thus, the assignment technique from CPU11 is distinguished, and by processing according to either application unit assignment, command assignment or polygon unit assignment, a scan method is determined and it directs to the source address generating section 103 and the drawing address generation section 104 (1110).
[0033] Drawing 4 (a) shows an example of the command list of a graphics processor 10. A command list is set up for every polygon and stored in the command memory 13. An operation code shows the class of command. The parameter has prescribed the conditions which accompany a command. The scanning mode appointed field is the field which chooses the scan method of texture mapping. In source address information, the starting address of source data, size, and drawing address information specify a drawing starting address and a configuration. The number of Rhine which draws from this address information is computable. The attribute has described the reference data of the image-processing data used by the pixel operation part 105.
[0034] Drawing 4 (b) shows the detail of the command field of scanning mode assignment information. This command is CPU11 in fixed mode, and is created by CPU11 and the graphics processor 10 with automatic mode.
[0035] 2 bits of command analysis section high orders express a scanning mode assignment bit (SD), and they specify the processing technique for determining the scan mode of texture mapping. The technique of SD=00 is in fixed mode and there is no modification in scan mode. The technique of SD=01 is automatic mode, according to each rice bull bit of a graphic form kind judging (S), a window judging (W), and an oblateness judging (H), a scan method is determined automatically, and dynamic modification of a scan method is attained by this. It is in a source level scan by SD=10, its drawing level scan is in a command list by SD=11, and the individual assignment mode of a polygon unit is specified.
[0036] A graphic form kind judging rice bull bit (S) is a bit which permits considering the registered graphic form kind as a drawing level scan. A window judging rice bull bit (W) is a bit which permits considering the graphic form drawn outside the registered window as a drawing level scan. An oblateness judging rice bull bit (H) calculates the oblateness or its amount of evaluations of the graphic form drawn, and when larger than the registered threshold, it is the bit which permits drawing with a drawing level scan.
[0037] The conceptual diagram of automatic setting of the scan method by window judging is shown in drawing 5 . The specific window 1201 is set as Screen 1200. Graphic forms 1202 other than a window and 1206-1209 consist of stationary simple graphic forms. The graphic form 1203-1205 in a window assumes the screen of the cockpit of a spacecraft, at high speed, moves, and deforms, the complicated configuration is carried out, and drawing has taken much time amount. Therefore, the whole processing is accelerable if the graphic form in a window is drawn at a high speed. At this example, the graphic form in a window is drawn with a high-speed drawing level scan by setting a window judging rice bull bit (W) to 1.
[0038] The conceptual diagram for asking drawing 6 for the oblateness of a graphic form is shown. By the conceptual diagram which normalized the top-most vertices B of a square ABCD as a zero, the X coordinate of Ya and top-most vertices C defines it as Xc, and Y coordinate defines Xa and Y coordinate for the X coordinate of top-most vertices A as Yc. This drawing (a) shows the case of Ya>=Yc and this drawing (b) shows the case of Ya<Yc.
[0039] It is the index which quantifies the deformation of a drawing image compared with oblateness in a source image. The inclination of the side on either side of overwrite occurring frequently is the case that near and graphic form height are horizontally low, to a base. For this reason, maximum (AI of drawing 6) of graphic form height can be made into the amount of evaluations.
[0040] The oblateness of a graphic form can be distinguished by comparing the height of a source graphic form with the height of a drawing graphic form. Distance AE can be resembled if height AI of a drawing graphic form has small angle CBF in the case of drawing 6 (a). Distance AE is the distance AG-distance EG, and distance AG can be calculated with Ya and it can

calculate distance EG with Xa*Yc/Xc. A triangle BGE and a triangle BFC are analogs and this is because EG:CF=BG:BF is materialized. In this case, the value of calculated AE includes the error compared with the value of true AI. However, AI does not exceed AE.
[0041] Similarly, since AI can be approximated with AK in the case of drawing 6 (b), it is calculable with AK=Xc*Ya/Yc-Xa from AK=JB and JB=JG-BG. A triangle JGA and a triangle BFC are analogs and this is because JG:BF=AG:CF is materialized. Although AK calculated also in this case includes the error compared with true AI, AI does not exceed AK.
[0042] Although the amount of evaluations of oblateness was made into graphic form height in the above-mentioned example, it is good also by the include angle (the angle ABC of drawing 6) which height, the ratio of a base and a base, and the side side make. In addition, graphic form height is applicable also to the decision of the number of drawing Rhine mentioned later.
[0043] According to this example, a high-definition source level scan and a high-speed drawing level scan can be automatically chosen as a scan method of texture mapping according to the assignment from CPU, a predetermined polygon property, etc.
[0044] Moreover, since a scan method can be dynamically changed according to the oblateness calculated from inside-and-outside relation or a polygon configuration with graphic form classification and a specific window, it can improve in both processability and image quality. In addition, selection by the drawing processing time demanded is also possible as one of the criteria.
[0045] Next, the technique of accelerating a source level scan is explained with reference to drawing 4 (b) as other examples of this invention.
[0046] By the source level scanning method, in order to scan and draw only the height of the source, if the drawing image is carrying out flat, much overwrite will occur. For this reason, the height of the graphic form which draws is calculated, the number of Rhine required for drawing is acquired, and if the scan of the source is thinned out and it draws so that this number of Rhine may be suited, only that part can accelerate processing.
[0047] The skip mode (KM) of the scanning mode appointed field is assignment from CPU11 or a graphics processor 10, and changes the number of scan lines of a source level scan. The Rhine skip is performed by the pattern which specified only the number of Rhine which specified by ** Rhine drawing KM=00 and was specified with the number LN (8 bits) of scan lines by KM=01 by the scan **** pattern PT (8 bits) by drawing and KM=10.
[0048] At the time of KM=01, when drawing Rhine of LN book, it is necessary to average and thin out. For this reason, L=L+M repeats and determines scan line L on the basis of the number LN of drawing Rhine (M=LN). When it comes to L> (the total number AN of Rhine of the source), the decision of the scan line by above-mentioned L=L+M is repeated, using the fraction (overspeed) as new M (= L-AN).
[0049] At the time of KM=10, although infanticide is directed by the pattern of PT, it scans from the high order bit of PT, it moves to next Rhine without drawing, if an applicable bit is 1, and if an applicable bit is 0, it will draw. If it comes to the least significant bit, it will return and repeat to the most significant bit of PT again. For example, PT pattern of 50% infanticide is the case (10101010) where the field is 8 bits.
[0050] In the above-mentioned example, although the number LN of drawing Rhine is set up with the command from CPU, the bit of oblateness is prepared in the scanning mode appointed field, and it is also easily realizable to set the number of scan lines automatically based on the graphic form height which is the amount of evaluations of oblateness. For example, the number of Rhine equivalent to the height of a drawing graphic form (the number of dots) is set up as the minimum value of the number of scan lines of a source graphic form.
[0051] The technique of improvement in the speed the source level scan by this example is conventionally [which does not have the scan method selection section 102 in a graphics processor 10] applicable also to the graphics equipment of a type as it is. In this case, the skip mode (KM) of the scanning mode appointed field is specified from CPU.
[0052] Rhine which according to the source level scan of this example should limit the number of Rhine of drawing or should draw — a number of — it is — a pattern setup of Rhine which does not draw is carried out, it is made to decide, before processing the number of processing Rhine

to operate on a curtailed schedule, and drawing is accelerable, maintaining image quality.
[0053] Next, drawing 7 – drawing 9 explain the example of 1 application of the hardware configuration which realizes the graphics equipment of this invention.
[0054] Drawing 7 shows the hardware configuration of the scan method setting section 102. The address MA from the command analysis section 101 is decoded by the address decoder 121, and Data MD are written in Rn from a register Ra 1. If a control signal Trig is inputted, a sequencer 122 will operate and the flow of drawing 3 will be performed using Rn from ALUa, ALUb, and a register Ra 1. The source address and the drawing address which were generated here are sent to the source address generating section 103 and the drawing address generation section 104 through Buses MLA and MLB.
[0055] Drawing 8 shows the block diagram of the source address generating section 103 and the drawing address generation section 104. DDA of writing and address generation is started for the address parameter created in the scan method setting section 102 to the register chosen by the address MA from the command analysis section 101. A source and drawing side also serves as the same configuration.
[0056] Drawing 9 shows the block diagram of the drawing section 105. Timing adjustment is carried out by latches 1054 and 1055, and the source data read in the address of the source address generating section 103 are inputted into the synthetic vessel 1056. Via latch 1051, it connects with a computing element 1052 and a register 1053, and interpolation processing of the superposition data DD generated in the scan method setting section 102 is carried out. It connects with the input of one of the two of the synthetic vessel 1056, and this data by which interpolation processing was carried out is compounded with source data, and writes in the drawing memory 15 via latch 1057.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The block block diagram of the graphics equipment by one example of this invention.
[Drawing 2] The conceptual diagram explaining the scan technique of texture mapping.
[Drawing 3] The processing flow chart which chooses a scan method.
[Drawing 4] The command list of a graphics processor, and the explanatory view of a command field.
[Drawing 5] The conceptual diagram explaining the automatic decision of the scan method by window judging.
[Drawing 6] The conceptual diagram explaining the count approach of oblateness.
[Drawing 7] The hard block diagram of the scan method selection section.
[Drawing 8] The hard block diagram of the source address generating section and the drawing address generation section.
[Drawing 9] The hard block diagram of the drawing section.
[Description of Notations]
10 [-- Command memory, 14 / -- Source memory, 15 / -- Drawing memory, 16 / -- Display memory, 101 / -- The command analysis section, 102 / -- The scan method selection section, 103 / -- The source address generating section, 104 / -- The drawing address generation section, 105 / -- The drawing section, 106 / -- The display address generation section, 107 / -- A display, 108 / -- Switch.] -- A graphics processor, 11 -- CPU, 12 -- Program memory, 13

[Translation done.]

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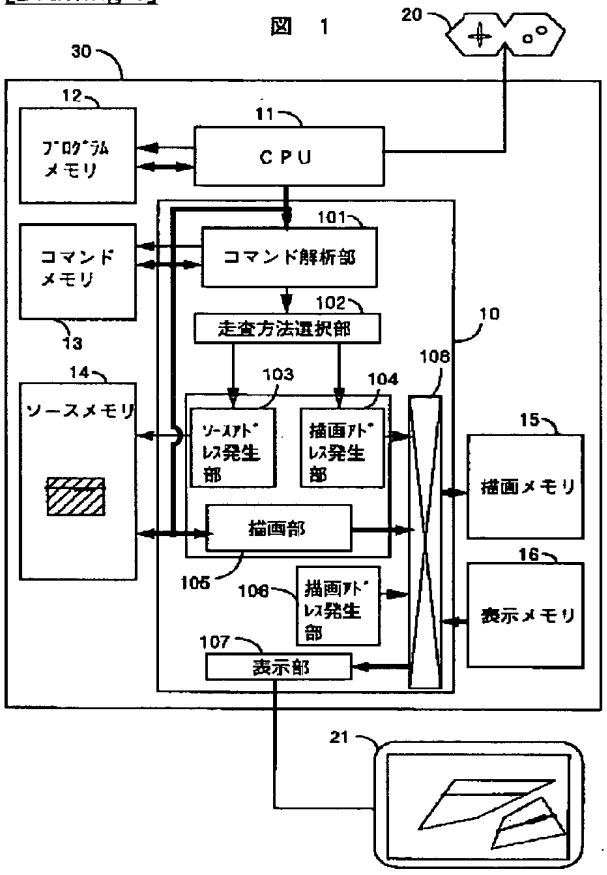
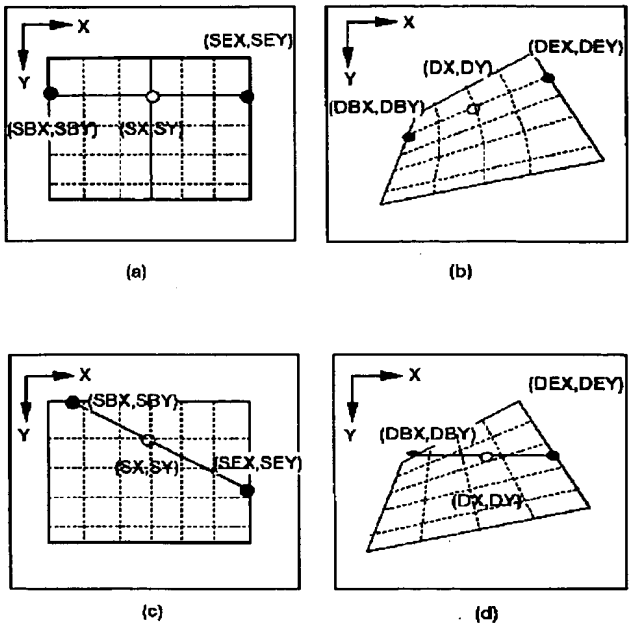
DRAWINGS

[Drawing 1]



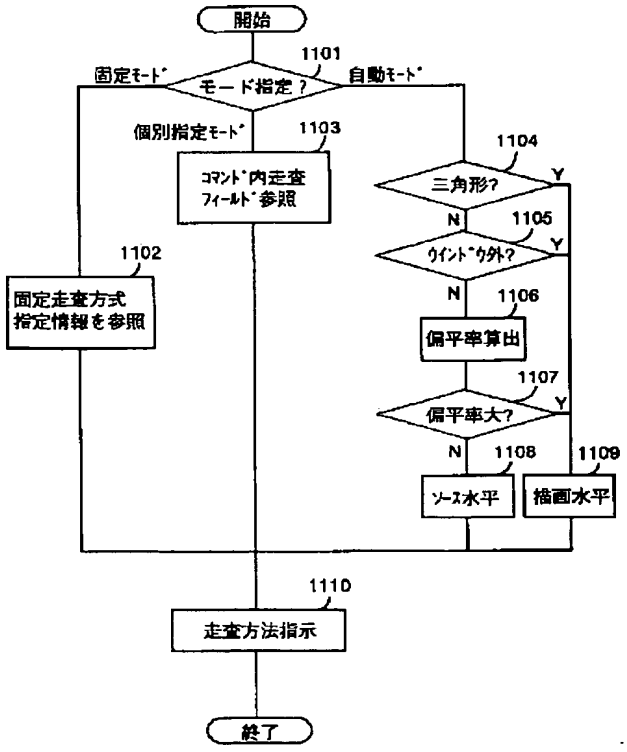
[Drawing 2]

図 2



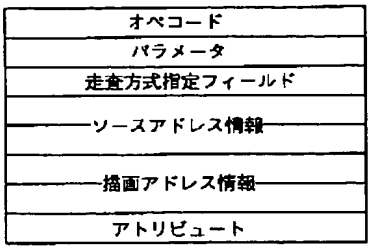
[Drawing 3]

図 3

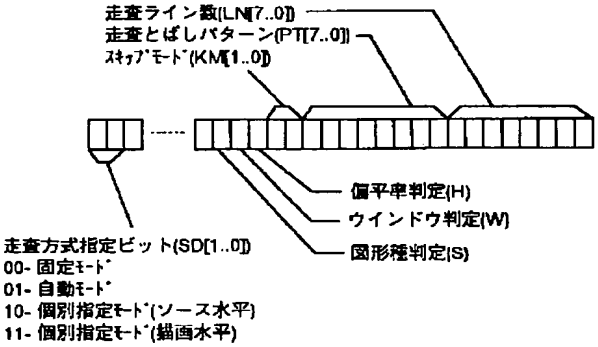


[Drawing 4]

図 4



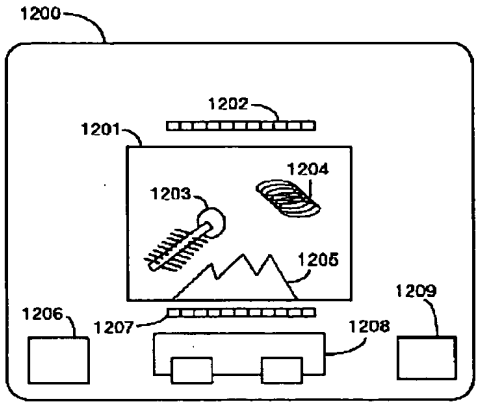
(a)



(b)

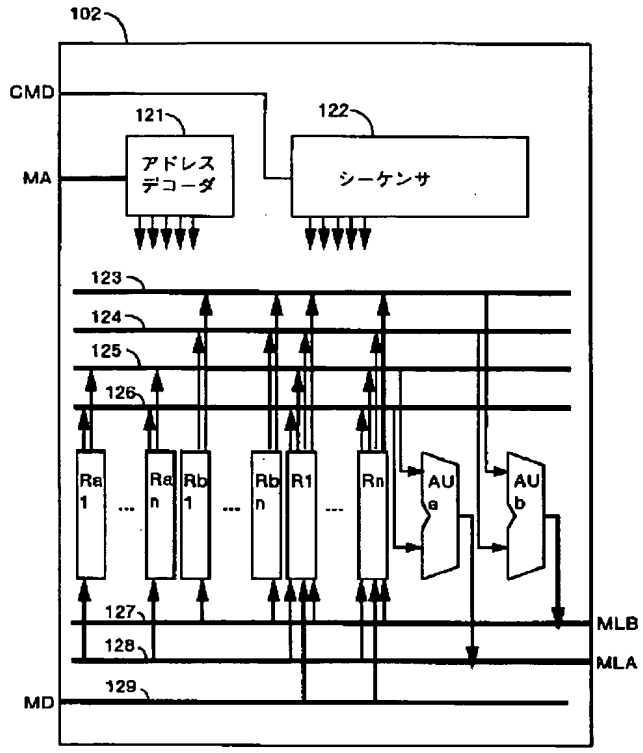
[Drawing 5]

図 5



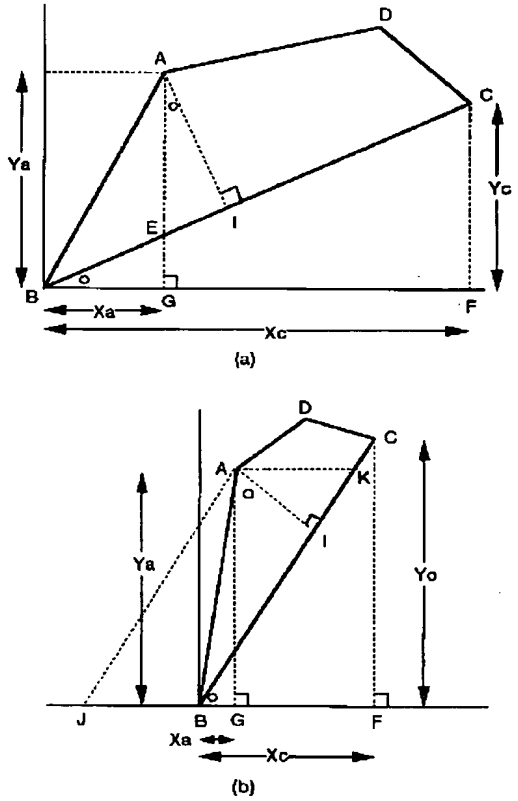
[Drawing 7]

図 7



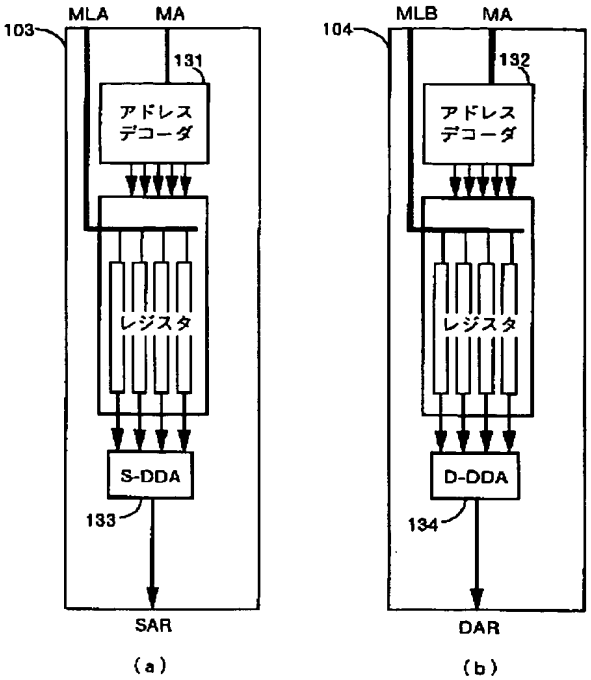
[Drawing 6]

図 6



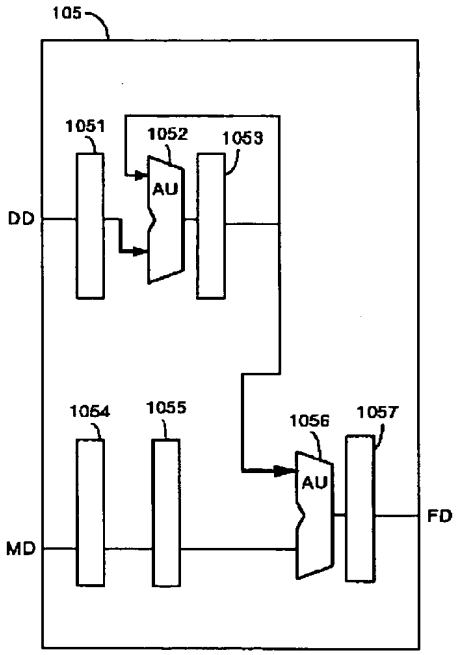
[Drawing 8]

図 8



[Drawing 9]

図 9



[Translation done.]

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最終頁に続く

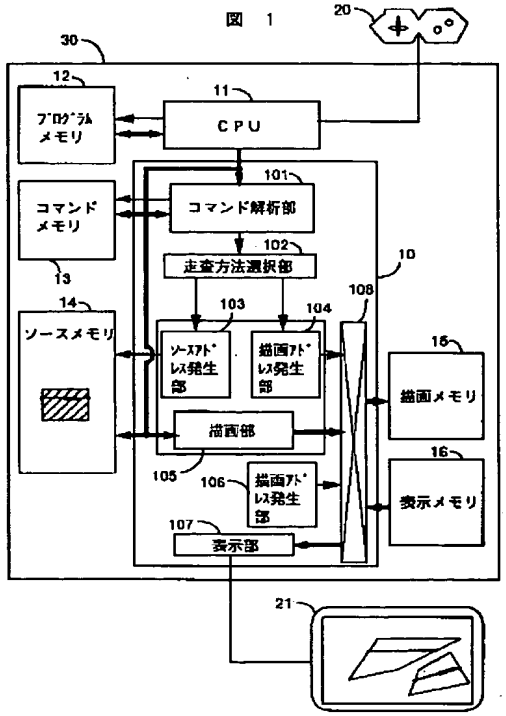
(54)【発明の名称】　描画方法およびグラフィックス装置

(57)【要約】

【目的】高画質を保ちながら高速のテクスチャーマッピング処理を行うグラフィックス装置を提供することにある。

【構成】グラフィックスプロセッサ１０に走査方法選択部１０２を設け、ソース画像領域のデータを１ドットづつ水平スキャンするモードと、描画画像領域のデータを１ドットづつ水平スキャンするモードの一方を、コマンドからの指定や図形の性質（角数や偏平率計算結果）により選択する。

図 1



1

【特許請求の範囲】

【請求項１】　ソース画像を自在に変形して描画するテクスチャーマッピングによる描画方法において、
テクスチャーマッピングの走査方法として、ソース画像領域を１ドットづつ水平スキャンして描画画像領域へマッピングする走査（以下、ソース水平スキャンと呼ぶ）、または、前記描画画像領域を１ドットづつ水平スキャンし前記ソース画像領域からマッピングする走査（以下、描画水平スキャンと呼ぶ）を、所定の判定基準に応じて動的に選択することを特徴とする描画方法。

【請求項２】　請求項１において、
前記判定基準は、描画図形の種類がｎ角形以下、描画図形が特定ウインドウの外部（または内部）、描画図形の変形の程度を示す偏平率が閾い値より大で、これらの一つを満足するときは前記描画水平スキャンを選択し、これらの全てを満足しないときは前記ソース水平スキャンを選択することを特徴とする描画方法。

【請求項３】　請求項２において、
前記偏平率は、描画図形の最大高さまたは最大高さ／底辺を算出して求めることを特徴とする描画方法。

【請求項４】　ソース画像を自在に変形して描画するテクスチャーマッピングによる描画方法において、
ソース画像領域を１ドットづつ水平スキャンして描画画像領域へマッピングする走査で、ソース画像領域の走査ライン数を間引き指定することを特徴とする描画方法。

【請求項５】　請求項４において、
前記間引き指定する走査ライン数は、前記描画画像領域の図形高さに相当する走査ライン数を最小値とすることを特徴とする描画方法。

【請求項６】　描画すべき画像を指示するＣＰＵと、ソース画像領域と描画画像領域をそれぞれ有する画像メモリと、前記ソース画像領域のデータを前記描画画像領域へテクスチャーマッピングする描画プロセッサを備えるグラフィックス装置において、
前記描画プロセッサは、前記テクスチャーマッピングの複数の走査方法の一つを前記ＣＰＵからのモードの指定に応じて決定する走査方法選択手段を有することを特徴とするグラフィックス装置。

【請求項７】　請求項６において、
前記複数の走査方法に、前記ソース画像領域を１ドットづつ水平スキャンし描画画像領域へマッピングする走査（以下、ソース水平スキャンと呼ぶ）と、前記描画画像領域を１ドットづつ水平スキャンしソース画像領域からマッピングする走査（以下、描画水平スキャンと呼ぶ）を含むグラフィック装置。

【請求項８】　請求項６または７において、
前記モードの指定には、アプリケーション単位の固定モード、ポリゴン単位の固定モード、前記描画プロセッサ側で決定する自動モードを含むことを特徴とするグラフィック装置。

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【請求項９】　請求項７において、
前記ＣＰＵからのコマンド中に、前記ソース水平スキャンまたは前記描画水平スキャンを指定するフィールドを含むことを特徴とするグラフィックス装置。

【請求項１０】　請求項８において、
前記走査方法選択手段は、前記ＣＰＵからのコマンドに前記自動モードが指定されている場合に、所定の判定条件に従ってポリゴン毎の走査方法を動的に決定することを特徴とするグラフィックス装置。

【請求項１１】　請求項１０において、前記自動モードは、描画図形の図形種が三角形、描画図形が特定のウインドウの外部（内部）、描画図形の偏平率が閾い値より大からなる判定条件の一つを満足するときは前記描画水平スキャンを、前記判定条件の全てを満足しないときは前記ソース水平スキャンを選択することを特徴とするグラフィックス装置。

【請求項１２】　請求項１１において、
前記走査方法選択手段は、テクスチャーマッピングを実施する描画図形の偏平率を算出する演算手段を有することを特徴とするグラフィックス装置。

【請求項１３】　描画すべき画像を指示するＣＰＵと、ソース画像領域と描画画像領域をそれぞれ有する画像メモリと、前記ソース画像領域のデータを前記描画画像領域へテクスチャーマッピングする描画プロセッサを備えるグラフィックス装置において、
前記ＣＰＵまたは前記描画プロセッサのコマンド中に、ソース画像領域を１ドットづつ水平スキャンして描画画像領域へマッピングする走査で、ソース画像領域の走査ライン数を間引き指示するフィールドを有することを特徴とするグラフィックス装置。

【請求項１４】　請求項１３において、
前記走査ライン数は、描画画像を描画するライン数をポリゴンの頂点座標位置に基づいて演算した値を設定することを特徴とするグラフィックス装置。

【請求項１５】　請求項１３または１４において、
前記フィールドは、ビット位置に対応して描画するラインと描画しないラインを指定する複数のビットを有することを特徴とするグラフィックス装置。

【請求項１６】　描画すべき画像を指示するＣＰＵと、ソース画像領域と描画画像領域をそれぞれ有する画像メモリと、前記ソース画像領域のデータを前記描画画像領域へテクスチャーマッピングする描画プロセッサを備えるグラフィックス装置において、
前記描画プロセッサは、前記テクスチャーマッピングの走査方法として、前記ソース画像領域を１ドットづつ水平スキャンし描画画像領域へマッピングする走査（以下、ソース水平スキャンと呼ぶ）と、前記描画画像領域を１ドットづつ水平スキャンしソース画像領域からマッピングする走査（以下、描画水平スキャンと呼ぶ）の一つを選択する走査方法選択手段を設け、

前記描画プロセッサのコマンド中に、前記ソース水平スキャンにおける前記ソース画像領域の走査ライン数を間引き指示するフィールドを有することを特徴とするグラフィックス装置。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明はアミューズメント機器、画像通信端末、プリンタなどで使用され、画像データを加工、編集して出力するグラフィック装置に関し、特に、テクスチャーマッピング描画方法に関する。

【０００２】

【従来の技術】近年、グラフィックス装置では、テクスチャーマッピングと呼ばれる矩形のソース画像を自在に変形描画する処理を実現し、臨場感に溢れる３次元グラフィックスを実現している。このテクスチャーマッピングの描画は、特開平６－２８４８５号記載のように、テクスチャーアドレスを発生する手段として、ソース画像領域を１ドットづつ水平スキャンし描画画像領域へマッピングするモード（以下、ソース水平スキャンと呼ぶ）、あるいは、特開平１－３２３９３号記載のように、描画画像領域を１ドットづつ水平スキャンしソース画像領域からマッピングするモード（以下、描画水平スキャンと呼ぶ）を固定的に使用していた。

【０００３】

【発明が解決しようとする課題】上記従来の技術では、それぞれのテクスチャマッピング走査方法の利害得失を有効に利用できないという問題があった。つまり、ソース水平スキャンでは、自然な３次元画像を生成できるが、偏平した画像を描画する際、描画画像の抜けを防止するために重ね書きが多数発生し、描画速度が極端に低下するという問題があった。一方、描画水平スキャンでは、上記のような重ね書きは発生しないが、四角形を描画する際、画像が平面的になり、不連続性が目立つという問題があった。

【０００４】本発明の目的は、テクスチャマッピングによる高速で高画質な描画方法と、その手法を応用したグレードの高いグラフィックス装置を提供することにある。

【０００５】

【課題を解決するための手段】上記目的を達成するための本発明の特徴は、ソース画像を自在に変形して描画するテクスチャーマッピングによる描画方法において、テクスチャーマッピングの走査方法として、ソース画像領域を１ドットづつ水平スキャンして描画画像領域へマッピングする走査（以下、ソース水平スキャンと呼ぶ）、または、前記描画画像領域を１ドットづつ水平スキャンし前記ソース画像領域へマッピングする走査（以下、描画水平スキャンと呼ぶ）を、所定の判定基準に応じて動的に選択することにある。

【０００６】前記判定基準は描画図形の種類がｎ角形以下、描画図形が特定ウインドウの外部（または内部）、描画図形の変形の程度を示す偏平率が閾い値より大であり、これらの一つを満足するときは前記描画水平スキャンを選択し、これらの全てを満足しないときは前記ソース水平スキャンを選択する。

【０００７】このような描画方法を応用する装置として、描画すべき画像を指示するＣＰＵと、ソース画像領域と描画画像領域をそれぞれ有する画像メモリと、前記ソース画像領域のデータを前記描画画像領域へテクスチャーマッピングする描画プロセッサを備え、前記描画プロセッサは、前記テクスチャーマッピングの複数の走査方法の一つを、前記ＣＰＵからのモードの指定に応じて決定する走査方法選択手段を有することを特徴とするグラフィックス装置として実現される。

【０００８】前記モードの指定には、アプリケーション単位の固定モード、ポリゴン単位の固定モード、前記描画プロセッサ側で決定する自動モードを含み、該自動モードの場合には、前記判定条件に従ってポリゴン毎の走査方法を動的に決定する。

【０００９】上記目的を達成するための本発明の他の特徴は、ソース画像を自在に変形して描画するテクスチャーマッピングによる描画方法において、前記ソース水平スキャンのソース画像領域の走査ライン数を間引き指定することにある。

【００１０】前記間引き指定する走査ライン数は、前記描画画像領域の図形高さに相当する走査ライン数を最小値とする。

【００１１】このような描画方法を応用する他の装置として、描画すべき画像を指示するＣＰＵと、ソース画像領域と描画画像領域をそれぞれ有する画像メモリと、前記ソース画像領域のデータを前記描画画像領域へテクスチャーマッピングする描画プロセッサを備え、前記ＣＰＵまたは前記描画プロセッサのコマンド中に、前記ソース水平スキャンにおけるソース画像領域の走査ライン数を間引き指示するフィールドを有することを特徴とするグラフィック装置として実現される。

【００１２】

【作用】本発明によると、コマンドによる指定や描画図形の性質等に応じて、高画質なソース水平スキャンまたは高速な描画水平スキャンを選択してテクチャーマッピングを実行するため、描画の処理性と画質をともに向上できる。

【００１３】特に、描画図形の種別や特定ウインドウとの関係あるいは変形の程度などをポリゴン毎に判定して、画質と処理性の両面からみた最適な走査方法を動的に決定できるので、グレードの高いグラフィックス装置を提供できる。

【００１４】また、前記ソース水平スキャンのソース描画ライン数を間引き指定することができるため、画質を維持しながら処理性を向上でき、実時間に追随できる所

定時間内などに描画処理を完了することも可能になる。

【００１５】

【実施例】以下、本発明の一実施例を図を参照して説明する。

【００１６】図１は本発明の一実施例の高速グラフィックス装置３０のブロック構成図である。高速グラフィックス装置３０は、入力パッド２０の指示に基づき、ＣＰＵ１１でアプリケーションプログラムを実行し、グラフィックスプロセッサ１０に描画すべき画像を指示する。描画プロセッサ１０は描画メモリ１５、表示メモリ１６を用いて所望の画像を合成し、表示部１０７を経由しモニタ２１に表示する。

【００１７】以下、本装置の動作を説明する。ＣＰＵ１１は、プログラムメモリ１２を用いて処理すべきコマンドおよびソースデータを作成し、グラフィックスプロセッサ１０に転送する。グラフィックスプロセッサ１０は、コマンドおよびソースデータを一時的にコマンドメモリ１３とソースメモリ１４に記憶する。このコマンドにはグラフィックスプロセッサ１０自身で生成したものを含む。

【００１８】その後、ＣＰＵ１１は実行開始コマンドを発行する。グラフィックスプロセッサ１０内のコマンド解析部１０１は、実行開始コマンドにより、コマンドメモリ１３からコマンドを取りだし、必要なパラメータを走査方法選択部１０２に転送し、起動する。

【００１９】走査方法選択部１０２は、コマンド解析部１０１からのコマンドやパラメータに従って走査方法を決定する。そして、ソースデータの格納されている座標および描画座標を計算し、ソースアドレス発生部１０３を起動する。同様に、描画結果を格納する座標および描画座標を計算し、描画アドレス発生部１０４を起動する。

【００２０】ソースアドレス発生部１０３及び描画アドレス発生部１０４では、走査方法選択部１０２より指定されたテクスチャーマッピングの走査手法で、ソースデータの格納されている座標および描画座標を演算し、ソースメモリ１４と描画メモリ１５をアクセスする。すなわち、指定された走査方法がソース水平スキャンの場合は、ソース画像領域を１ドットづつ水平スキャンし描画画像領域へマッピングする。また、描画水平スキャンの場合は、描画画像領域を１ドットづつ水平スキャンしソース画像領域からマッピングする。

【００２１】ソースメモリ１４から読み出されたソースデータは、描画部１０５で加工処理され、描画メモリ１５に書き込まれる。描画メモリ１５と表示メモリ１６はスイッチ１０８で切り替わる交代バッファをなしており、前のフレームにて書き込まれた画像は表示メモリ１６に格納されている。表示アドレス発生部１０６で発生したアドレスで表示メモリ１６をアクセスし、読み出しデータを、表示部１０７を経由しモニター２１に出力し、表示する。

【００２２】図２は、テクスチャーマッピングの走査方法の概念図である。同図（ａ）、（ｂ）はソース画像領域のデータを１ドットづつ水平スキャンし描画画像領域へマッピングするソース水平スキャンを示しており、（ａ）がソース側の走査処理、（ｂ）が描画側の走査処理を示している。図示のように、このモードではソース側のＹ座標を固定し、ソース側のＸ座標を１ドットづつ進め、これが描画側のどの位置にマッピングされるかを計算し、描画する。

【００２３】ソース水平スキャンによる描画方法では、ソースの四角形を横方向に細かな短冊状に切り、描画側の対応する辺の位置に合わせて張り付けていくため、図２（ｂ）のように垂直な線分が曲がって再現されて擬似立体的な表現が可能になり、見た目に自然な画像を生成できるメリットがある。しかし、描画画像の形状、サイズにかかわらず原画像をすべて走査するための時間が必要であり、また、特に描画画像が偏平していると重ね書きが頻発し、多大な描画時間を必要とするという欠点がある。

【００２４】図２（ｃ）、（ｄ）は描画画像領域を１ドットづつ水平スキャンしソース画像領域からマッピングする描画水平スキャンを示しており、（ｃ）がソース側の走査処理、（ｄ）が描画側の走査処理を示している。図示のように、このモードでは描画側のＹ座標を固定し、描画側のＸ座標を１ドットづつ進め、これがソース側のどの位置からマッピングされるかを計算し、ソースデータをアクセスする。

【００２５】描画水平スキャンによる描画方法では、描画される部分から逆算するため、不必要な重ね書きが全く発生せず、高速な描画が可能になるメリットがある。しかし、描画面が平面形状でない、例えばねじれた曲面へのテクスチャーマッピングなどの場合は、ソース画像の逆算時間が増大して実用的でなくなる。また、３次元描画の場合はポリゴンが四角形以上になると、テクスチャーマッピング後の画像に不自然な歪みが発生する。これは、逆算時のソースのマッピング位置が複数個存在するにもかかわらず、採用ルールが統一的に適用されないために生ずる。

【００２６】本発明は、テクスチャーマッピングの複数の走査方法をコマンドで指定したり、描画図形の性質等から最適な走査方法を自動選択したりして、高速で画質の良いグラフィックス装置を実現するもので、以下にその詳細を説明する。

【００２７】図３は、走査方法選択部による走査方法の決定処理フローを示している。走査方法の決定方式には大別してアプリケーション単位指定、コマンド指定、ポリゴン単位指定の３のモードがある。まず、ＣＰＵ１１のコマンドによる指定モードを判別して（１１０１）、モードに応じた走査方法の決定処理を実行する。

【００２８】アプリケーション単位指定は、もっともマクロな指定方法であり固定モードである。たとえば、ゲームのカートリッジのＲＯＭなどに、アプリケーション単位で、テクスチャーマッピングの走査方法を予め記憶している。自然な画像表現が必要なものにはソース水平スキャン、高速描画が必要なものには描画水平スキャンを、それぞれ固定走査方式指定情報として記述し、この情報を参照して走査方法を決定する（１１０２）。固定走査方式指定情報は、コマンド内の走査フィールドに後述のように記述されている。

【００２９】コマンド指定は、描画図形の種類を示す図形の角数ｎ、描画座標位置と特定ウインドウの内外関係、描画図形の形状を示す偏平率などの判定条件により、テクスチャーマッピングの走査方法を動的に決定する自動モードである。本実施例での図形の角数ｎは、テクスチャーマッピング後に不自然な歪みの発生しない三角形を判定基準としている。

【００３０】コマンド指定による走査方法の決定アルゴリズムは、描画図形の種類が三角形か判定し（１１０４）、描画図形が所定のウインドウ外か判定し（１１０５）、いずれも否（ＮＯ）であれば偏平率を計算し（１１０６）、偏平率が閾い値より大きいか判定し（１１０７）、閾い値より小さければソース水平スキャンを選択し（１１０８）、上記判定でいずれかを満たしていれば（ＹＥＳ）描画水平スキャンを選択する（１１０９）。ここでは、単純に３つの判定基準を順番に並べたが、順番の変更や判定基準の組み合わせ、評価関数の導入、他の条件の追加など、種々の変形は容易に実現できる。

【００３１】ポリゴン単位指定とは、１ポリゴン毎に、走査方法を指定する固定モードである。コマンド内の走査フィールドに、後述のように指定されている走査方法を参照して決定する（１１０３）。

【００３２】このように、ＣＰＵ１１からの指定手法を判別し、アプリケーション単位指定、コマンド指定またはポリゴン単位指定のいずれかに応じた処理によって走査方法を決定し、ソースアドレス発生部１０３と描画アドレス発生部１０４へ指示する（１１１０）。

【００３３】図４（ａ）は、グラフィックスプロセッサ１０のコマンドリストの一例を示している。コマンドリストはポリゴン毎に設定され、コマンドメモリ１３に格納されている。オペコードはコマンドの種類を示す。パラメータはコマンドに付随する条件を規程している。走査方式指定フィールドは、テクスチャーマッピングの走査方法の選択を行うフィールドである。ソースアドレス情報はソースデータの開始アドレスやサイズ、描画アドレス情報は描画開始アドレスや形状を指定する。このアドレス情報から描画するライン数を算出できる。アトリビュートは、画素演算部１０５で用いる画像処理データの参照データを記述している。

【００３４】図４（ｂ）は、走査方式指定情報のコマンドフィールドの詳細を示している。このコマンドは、固定モードではＣＰＵ１１で、自動モードではＣＰＵ１１とグラフィックスプロセッサ１０によって作成される。

【００３５】コマンド解析部上位２ビットは走査方式指定ビット（ＳＤ）を表し、テクスチャーマッピングの走査モードを決定するための処理手法の指定を行う。ＳＤ＝００の手法は固定モードであり、走査モードの変更はない。ＳＤ＝０１の手法は自動モードであり、図形種判定（Ｓ）、ウインドウ判定（Ｗ）、偏平率判定（Ｈ）の各々のイネブルビットに応じて自動的に走査方法を決定し、これによって走査方法の動的な変更が可能になる。ポリゴン単位の個別指定モードは、ＳＤ＝１０でソース水平スキャン、ＳＤ＝１１で描画水平スキャンをコマンドリストにいて指定する。

【００３６】図形種判定イネブルビット（Ｓ）は、登録した図形種を描画水平スキャンとすることを許可するビットである。ウインドウ判定イネブルビット（Ｗ）は、登録したウインドウ外に描画される図形を描画水平スキャンとすることを許可するビットである。偏平率判定イネブルビット（Ｈ）は描画される図形の偏平率またはその評価量を計算し、登録した閾値より大きいときに描画水平スキャンで描画することを許可するビットである。

【００３７】図５に、ウインドウ判定による走査方法の自動設定の概念図を示す。画面１２００に特定ウインドウ１２０１が設定されている。ウインドウ以外の図形１２０２、１２０６－１２０９は、静止した単純な図形で構成されている。ウインドウ内の図形１２０３－１２０５は、例えば宇宙船の操縦席のスクリーンを想定していて、高速で移動、変形し、複雑な形状をしており、描画に多くの時間を要している。従って、ウインドウ内の図形を高速に描画すれば、全体の処理を高速化できる。本実施例では、ウインドウ判定イネブルビット（Ｗ）を１にすることで、ウインドウ内の図形を高速の描画水平スキャンで描画する。

【００３８】図６に、図形の偏平率を求めるための概念図を示す。四角形ＡＢＣＤの頂点Ｂを原点として正規化した概念図で、頂点ＡのＸ座標はＸａ、Ｙ座標はＹａ、頂点ＣのＸ座標はＸｃ、Ｙ座標はＹｃと定義する。同図（ａ）はＹａ≧Ｙｃの場合を示し、同図（ｂ）はＹａ＜Ｙｃの場合を示している。

【００３９】偏平率とは、ソース画像に比べて描画画像の変形量を定量化する指標である。重ね書きが頻発するのは、左右の辺の傾きが底辺に対して水平に近く、図形高さが低い場合である。このため、図形高さの最大値（図６のＡＩ）を評価量とすることができる。

【００４０】図形の偏平率は、ソース図形の高さと描画図形の高さを比較することで判別できる。図６（ａ）の場合、描画図形の高さＡＩは、角ＣＢＦが小さければ、距離ＡＥに近似することができる。距離ＡＥは距離ＡＧ－距離ＥＧであり、距離ＡＧはＹａ、距離ＥＧはＸａ＊

Ｙｃ／Ｘｃと計算できる。これは、三角形ＢＧＥと三角形ＢＦＣは相似形であり、ＥＧ：ＣＦ＝ＢＧ：ＢＦが成立するからである。この場合、求めたＡＥの値は真のＡＩの値に比べて誤差を含んでいる。しかし、ＡＩがＡＥを超えることはない。

【００４１】同様に、図６（ｂ）の場合、ＡＩはＡＫと近似できるので、ＡＫ＝ＪＢ、ＪＢ＝ＪＧ－ＢＧより、ＡＫ＝Ｘｃ＊Ｙａ／Ｙｃ－Ｘａと計算できる。これは、三角形ＪＧＡと三角形ＢＦＣは相似形で、ＪＧ：ＢＦ＝ＡＧ：ＣＦが成立するからである。この場合も、求めたＡＫは真のＡＩに比べて誤差を含んでいるが、ＡＩがＡＫを超えることはない。

【００４２】上記の例では偏平率の評価量を図形高さとしたが、高さと底辺の比や底辺と側辺がなす角度（図６の角ＡＢＣ）によってもよい。なお、図形高さは後述する描画ライン数の決定にも利用できる。

【００４３】本実施例によれば、テクスチャーマッピングの走査方法として、高画質のソース水平スキャンと高速な描画水平スキャンを、ＣＰＵからの指定や所定のポリゴン性質等に応じて自動的に選択できる。

【００４４】また、図形種別、特定ウインドウとの内外関係またはポリゴン形状より計算した偏平率などに応じて、ダイナミックに走査方法を切り替えることができるので、処理性と画質の両方を向上できる。なお、判定条件の一つとして、要求される描画処理時間による選択も可能である。

【００４５】次に、本発明の他の実施例として、ソース水平スキャンを高速化する手法を、図４（ｂ）を参照して説明する。

【００４６】ソース水平スキャン方式では、ソースの高さだけスキャンして描画するため、描画画像が偏平していると多数の重ね書きが発生する。このため、描画する図形の高さを計算して描画に必要なライン数を取得し、このライン数に合うようにソースのスキャンを間引いて描画すれば、その分だけ処理を高速化できる。

【００４７】走査方式指定フィールドのスキップモード（ＫＭ）は、ＣＰＵ１１またはグラフィックスプロセッサ１０からの指定で、ソース水平スキャンの走査ライン数を切り替える。ＫＭ＝００で毎ライン描画、ＫＭ＝０１で走査ライン数ＬＮ（８ビット）で指定したライン数のみ描画、ＫＭ＝１０で走査飛ばしパターンＰＴ（８ビット）で指定したパターンでラインスキップを実行する。

【００４８】ＫＭ＝０１のときは、ＬＮ本のラインを描画する場合に平均して間引く必要がある。このため、描画ライン数ＬＮを基点に走査ラインＬを、Ｌ＝Ｌ＋Ｍによって繰返し決定する（Ｍ＝ＬＮ）。Ｌ＞（ソースの全ライン数ＡＮ）となると、その端数（超過数）を新たなＭ（＝Ｌ－ＡＮ）として、上記のＬ＝Ｌ＋Ｍによる走査ラインの決定を繰り返す。

【００４９】ＫＭ＝１０のときは、ＰＴのパターンで間引きを指示するが、ＰＴの上位ビットからスキャンし、該当ビットが１であれば描画しないで次のラインに移り、該当ビットが０であれば描画する。最下位ビットまで来たら、再度ＰＴの最上位ビットに戻って繰り返す。例えば、５０％間引きのＰＴパターンは、フィールドが８ビットの場合（１０１０１０１０）である。

【００５０】上記の例では、ＣＰＵからのコマンドによって描画ライン数ＬＮを設定しているが、走査方式指定フィールドに偏平率のビットを設けて、偏平率の評価量である図形高さを基に、走査ライン数を自動設定することも容易に実現できる。たとえば、描画図形の高さに相当するライン数（ドット数）を、ソース図形の走査ライン数の最小値として設定する。

【００５１】本実施例によるソース水平スキャンの高速化の手法は、グラフィックスプロセッサ１０に走査方法選択部１０２を有しない、従来タイプのグラフィックス装置にもそのまま適用できる。この場合、走査方式指定フィールドのスキップモード（ＫＭ）は、ＣＰＵから指定される。

【００５２】本実施例のソース水平スキャンによれば、描画のライン数を限定したり、描画すべきライン数あるいは描画しないラインをパターン設定して、間引きする処理ライン数を処理前に確定させ、画質を維持しながら描画を高速化することができる。

【００５３】次に、本発明のグラフィックス装置を実現するハードウェア構成の一適用例を、図７～図９により説明する。

【００５４】図７は、走査方法設定部１０２のハードウエア構成を示している。コマンド解析部１０１からのアドレスＭＡをアドレスデコーダ１２１でデコードし、データＭＤをレジスタＲａ１からＲｎに書き込む。制御信号Ｔｒｉｇを入力したら、シーケンサ１２２が動作し、ＡＬＵａ、ＡＬＵｂとレジスタＲａ１からＲｎを用いて図３のフローを実行する。ここで生成されたソースアドレス、描画アドレスはバスＭＬＡ、ＭＬＢを通してソースアドレス発生部１０３、描画アドレス発生部１０４に送られる。

【００５５】図８はソースアドレス発生部１０３、描画アドレス発生部１０４のブロック図を示す。コマンド解析部１０１からのアドレスＭＡによって選択されるレジスタに走査方法設定部１０２で作成したアドレスパラメータを書込み、アドレス発生のＤＤＡを起動する。ソース側も描画側も同じ構成となる。

【００５６】図９は描画部１０５のブロック図を示す。ソースアドレス発生部１０３のアドレスで読み出したソースデータをラッチ１０５４、１０５５でタイミング調整し、合成器１０５６に入力する。走査方法設定部１０２で生成した重畳データＤＤは、ラッチ１０５１を経由し演算器１０５２とレジスタ１０５３に接続され補間処

理される。この補間処理されたデータは合成器１０５６の片方の入力に接続され、ソースデータと合成し、ラッチ１０５７を経由し描画メモリ１５に書込を行う。

【００５７】

【発明の効果】本発明によれば、コマンドによる指定や描画図形の性質等に応じて、高画質なソース水平スキャンまたは高速な描画水平スキャンを選択してテクチャーマッピングを実行するため、使い勝手がよく描画の処理性と画質をともに向上できる。

【００５８】本発明によれば、描画図形の性質などをポリゴン毎に判定して、画質と処理性の両面からみた最適な走査方法を動的に決定できるので、グレードの高いグラフィックス装置を提供できる。

【００５９】本発明によれば、ソース水平スキャンのソース描画ライン数を間引き指定することができるため、高画質なソース水平スキャンの処理性を向上できる。また、所定時間内（例えば、実時間あるいは処理終了予定時間）に描画処理を完了することも可能になる。

【図面の簡単な説明】

【図１】本発明の一実施例によるグラフィックス装置のブロック構成図。

【図２】テクスチャーマッピングの走査手法を説明する概念図。

【図３】走査方法の選択を行う処理フローチャート。

【図４】グラフィックスプロセッサのコマンドリストとコマンドフィールドの説明図。

【図５】ウインドウ判定による走査方法の自動決定を説明する概念図。

【図６】偏平率の計算方法を説明する概念図。

【図７】走査方法選択部のハード構成図。

【図８】ソースアドレス発生部及び描画アドレス発生部のハード構成図。

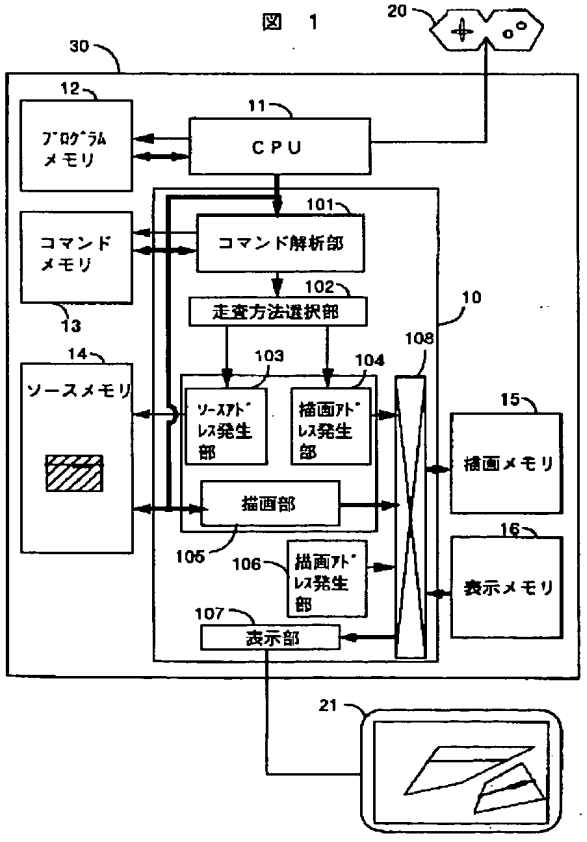
【図９】描画部のハード構成図。

【符号の説明】

１０…グラフィックスプロセッサ、１１…ＣＰＵ、１２…プログラムメモリ、１３…コマンドメモリ、１４…ソースメモリ、１５…描画メモリ、１６…表示メモリ、１０１…コマンド解析部、１０２…走査方法選択部、１０３…ソースアドレス発生部、１０４…描画アドレス発生部、１０５…描画部、１０６…表示アドレス発生部、１０７…表示部、１０８…スイッチ。

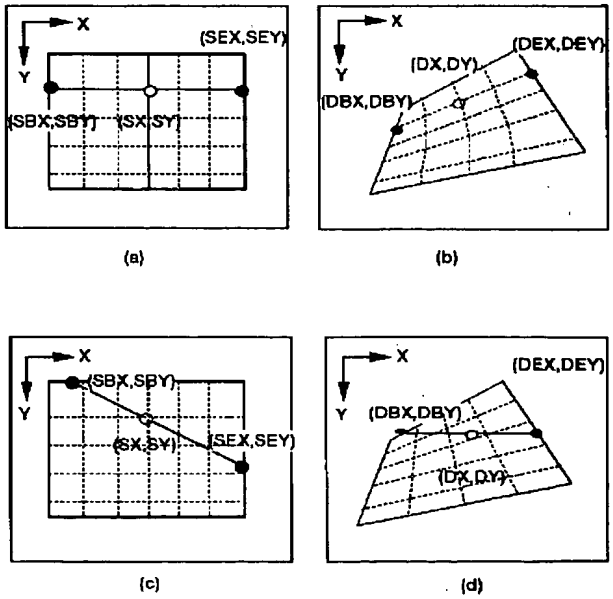
【図１】

図　1



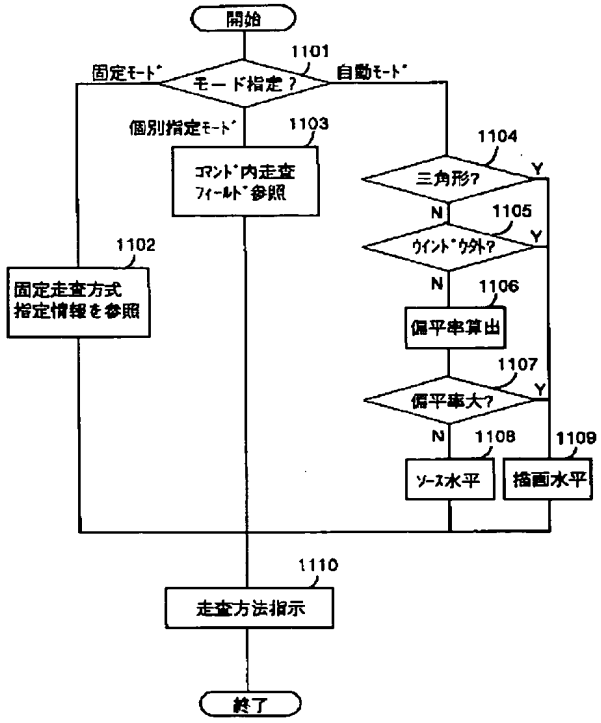
【図２】

図　2



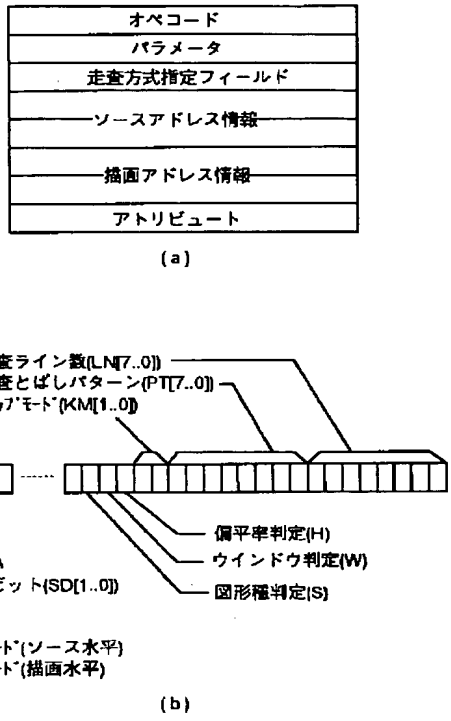
【図３】

図　3



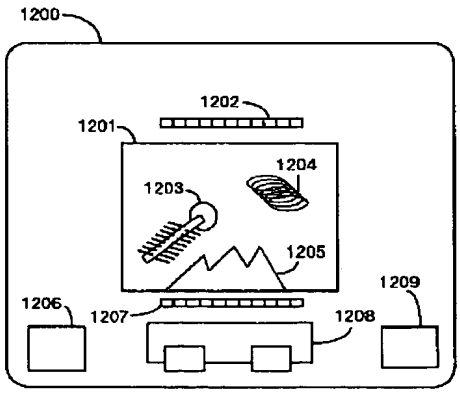
【図４】

図　4



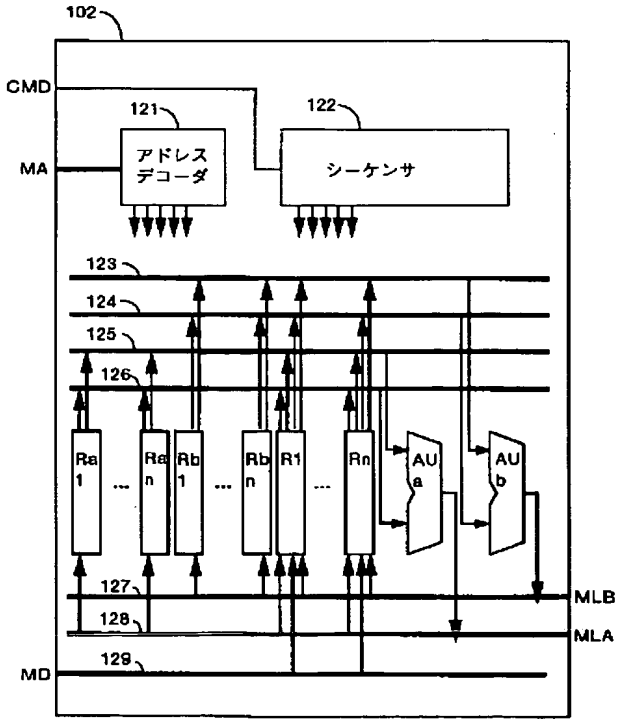
【図５】

図　5



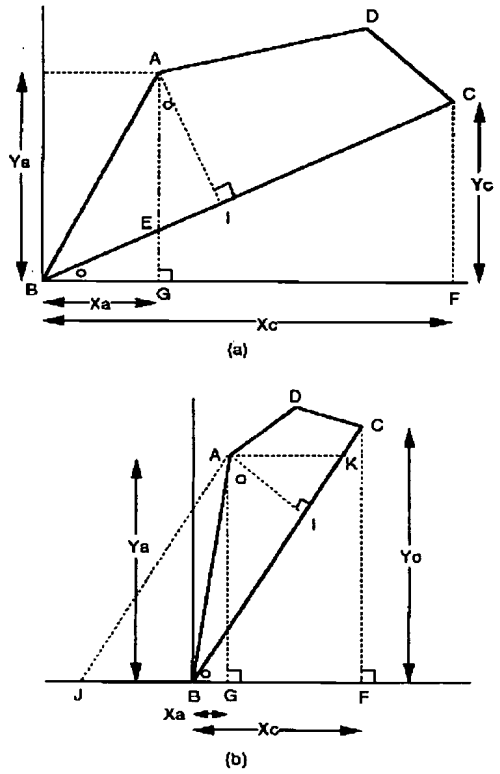
【図７】

図　7



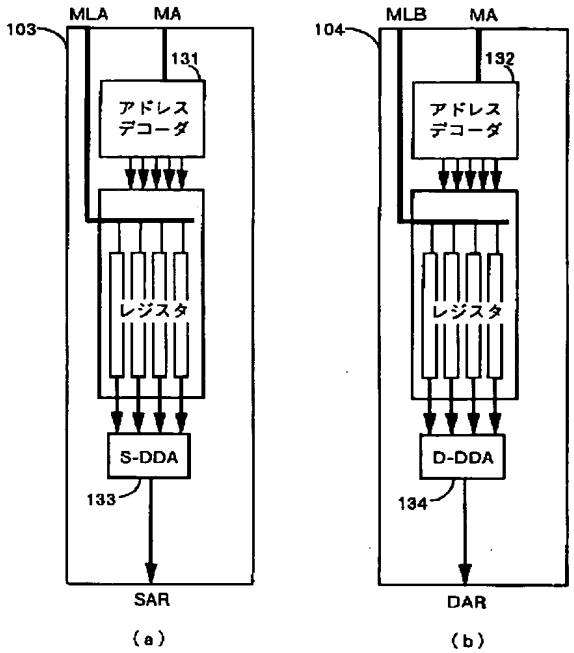
【図６】

図　6



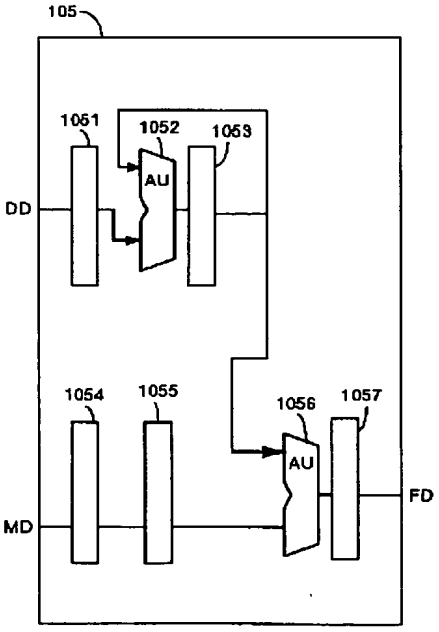
【図８】

図　8



【図９】

図　9



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